# Trends in Commercial-Off-The-Shelf vs. Proprietary Applications

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## ABSTRACT

*This study examines factors valued by IS managers in deciding if COTS software is a viable alternative to proprietary software. The results indicate managers who anticipate increased usage of COTS packages in 5 years used the same top three factors in the formation of their decisions to adopt COTS as their colleagues who anticipated either zero change in COTS usage or an increased usage of proprietary software used in deciding not to adopt COTS software. Managers anticipating increased COTS usage had a statistically significant higher value for each of those items compared to managers not anticipating growth in COTS software.*

***Keywords:*** *Commercial-Off-The-Shelf, Proprietary, Application Software*

## INTRODUCTION

The average information technology (IT) investment reported by organizations participating in the Society for Information Management's 36th Anniversary IT Trends Study was 5.3% of their gross revenue (Kappelman, et al., 2016) and IT contributes up to 50% of total capital costs (Applegate et. al. 2009). IT is essential to survival for most businesses. In the United States (US), President Obama requested a decrease of 2.9 percent in spending for IT projects for fiscal year 2015 bringing total requested IT spending for the United States Government to $79 billion (Information Week, 2014). This savings of $2.4 billion (2.9 percent) attributed to consolidation of commodity IT products and services, reduction of duplication, and cutting waste. Between 2011 and 2014 the Federal Government IT spending increased from $79.4 billion to $81.4 billion. Global spending on IT is expected to have a compound annual growth rate of 3.3 percent per year from 2015-2020 with IT products and services growing from almost $2.4 trillion in 2015 to over $2.7 trillion in 2020 (IDC, 2016). This increase is likely to be driven by demand for new technologies such as cloud computing, software as a service (SaaS) and Enterprise Resource Planning (ERP) packages among others Luftman et al. (2015).



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Businesses are becoming increasingly reliant upon information technology and are likely to continue to be so into the future. Driven by customer demands and desires for increased effectiveness and efficiency businesses are increasing usage of software solutions. The increased usage is fueling a growth in demand for IT applications and increasing the need for software both in the proprietary and commercial-off-the-shelf (COTS) domains and across ERP and non-ERP use cases. As an example, customers increasingly expect to be able to utilize smart phones and other mobile devices to accomplish an increasing array of tasks that were not previously possible with access to a full computer. This increased demand for more useful and powerful applications permeates an industry to the point that it becomes a basic expectation and any business not keeping current in their technological offerings is at a competitive disadvantage. Cloud computing, IT resource price decline, decreased costs of storage, and the increased processing power available at an affordable price point allows many small and medium size companies to afford IT applications for their organizations when they previously would not have been able to do so (Srinivasan 2013). These factors and others lead to a trend of annual increases in IT investments worldwide. Increased maturity in business intelligence, mobile computing, web-enabled transactions, and other areas are being seen as applications whose usage is beneficial for an increasing percentage of organization. However, limited available of resources is projected to lead to an increased reliance on cloud computing and outsourcing/offshoring services. Companies using cloud computing and/or offshoring/outsourcing, will have a decreased need for employees with higher IT skills (Himmel and Grossman, 2014). These trends in aggregate are expected to lead to a growth in the need for end user computing (EUC), the development and use of information systems by people outside the IS department (McLean 1979), within the organizations (Agrawal, et al. 2011).

The Information Technology (IT) market is experiencing global growth in IT investment but the high risk and cost involved in the development of application packages and the reduced life cycles for both products and systems (Turban et al., 2015) are factors that make it challenging for organizations to keep up with demand for application packages. This has led to alternate avenues evolving to overcome the significant backlog caused by the demand increase. These outlets include, but are not limited to, end-user computing, outsourcing, cloud computing, COTS packages, and ERP solutions. The exponential growth in capability per dollar in the technology sector for resources such as network capacity, processing power, storage, and other basic factors have led to a continuous growth in the usage of off-the-shelf/ERP solutions in business organizations (Agrawal 2005a). In the current study, the application packages are categorized as proprietary (non-ERP), proprietary (ERP), COTS (non-ERP), and COTS (ERP) packages. ERP packages are kept as a separate category because of their size and scope.

The theme of this research is to gain an understanding of the changing trends in the utilization of different categories of the application software. The objective of this study is to identify the current and future trends in the demand for different categories of software and the contributing factors influencing the future trends. The identification of both current and future trends in the demand for different categories of software will help organizations in formulating their IT strategies and their human resources planning. Further, the trends in usage of different categories of software



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will help academic institutions amend the curriculum offered to meet the changing needs of the business organizations. The specific research questions addressed are:

- What will be the trends in usage of various categories of application software?
- Will there be usage of COTS/ERP packages in higher proportion compared to proprietary packages?
- What contributing factors are driving the above trend of COTS solutions?

The present work conducts an analysis on the manufacturing sector and service sector. For the purpose of this study the manufacturing sector includes the automobile, computer hardware, pharmaceutical, telecommunication (hardware), and "other" industries. The service sector is comprised of the banking, retail, hotels, computer software, construction, government, healthcare, insurance, technology, transportation, utilities, and "other" industries. The quantitative and qualitative data were collected through a survey of Executives, Directors, First Line Managers, and Middle Managers from large, medium, and small scale organizations in the United States. This study offers projections of trends in usage of packages and the possible motivations of these trends. The study will help in identifying opportunities for both practitioners and researchers.

This article is organized in the following manner. First the literature review and development of the research model along with research hypotheses are presented. The measurement followed by the methodology section and the implementation of research methodology is presented. Finally, data processing and results follows the limitations of the study, implications for practice, suggestions for future work, and concluding remarks.

## BACKGROUND AND DEVELOPMENT OF RESEARCH MODEL

A review of the literature in information systems, operations, supply chain management, and related fields was conducted with the most relevant information found summarized below. The study is focused on the United States and is not represented as being generalizable to non-US companies. This design choice was made to increase the power of the statistical tests and as a matter of convenience and practicality.

The requirements trends for COTS, proprietary and ERP packages have been researched extensively as an area of considerable interest for IS researchers for decades. The history of ERP systems dates back to the early 1950's when Lyons Teashops used computers to plan material needs, take orders, plan for goods distribution and other functions (Rahman & Kurien, 2007). In the 1960's J.I. Case and IBM collaborated to develop Materials Requirement Planning software that was the forerunner to modern ERP systems (, although it would be the early 1990's before the actual ERP term was used by the Gartner Group (Sturdy, 2012). One of the first studies to quantify the trends was Agrawal (2005a). Figure 1 illustrates a model presented in Agrawal's paper and the parameters (Table 1) thought to influence application software trends in usage across multiple categories. This study uses the model for the design of a survey to test the model and potentially offer suggestions for how to improve the model's predictive validity. In Agrawal's study, the variables were shrinkage in systems life cycle, the high cost and risk prone tendency of the needed software, desired characteristics of the software solution, administrative motivations, and quantum improvements. The first four independent variables were hypothesized to lead to an increase in

the dependent variable, usage of off-the-shelf/ERP solutions while the last variable, quantum improvements, was hypothesized to lead to a decrease in the dependent variable. Each of the constructs, along with the expected relationships and hypotheses are discussed in six parts: proprietary software (including automation in application software development), and commercial-off-the-shelf software (including systems life cycle is shrinking, high cost and risk-prone tendency of the needed software, desired characteristics of software, administrative motivation, continuous improvements/quantum improvements).

Organizations are increasingly moving to the cloud to decrease their investments in IT infrastructure while also engaging in initiatives to reduce costs via productivity improvements, moving away from proprietary ERP usage to COTS ERP solutions, using COTS customer relationship management (CRM) solutions, and developing initiatives to generate additional revenue via CRM, analytics, and other IT enabled methods Luftman et al. (2015). Luftman et al. forecasts that over the next 3 – 5 years as organizations shift IT spending in a desire for flexibility and need for security cloud technologies will be one of the top investments in technology.

## PROPRIETARY SOFTWARE

As information technology has matured it has become more strategically vital in some areas while also being reduced to a role similar to a commodity in other areas. In 2003 Nicholas Carr's article "IT Doesn't Matter" (Carr, 2003) was published in the Harvard Business Review and almost instantly sparked passionate debate in academic circles. While the authors of this article do not want to rekindle a debate on the now distant article we believe that Carr's point was that IT no longer mattered in the way that it once did. At one time IT was valuable, rare, imperfectly imitable, and non-substitutable. In other words, it fits the criteria to be a resource that can be used to establish a sustainable competitive advantage according to the resource based view of the firm. According to the resource based view of the firm, in order for a firm to develop a sustainable competitive advantage the firm needs to have a resource, or resources, that is/are heterogeneous and immobile. Four attributes needed to achieve this are that the resources have to be valuable, rare, imperfectly imitable, and not substitutable by a resource that does not meet the previous three criteria (Barney, 1991). But by 2003 IT had become much more ubiquitous and high quality software packages were available to address many of the problems companies had once had to develop individually if they wanted to have a solution at all. Many IT solutions were no longer a strategic resource. Instead they were an expense that needed to be minimized to the extent possible while still meeting the organizations expectations at an acceptable level. But in areas where IT could be a strategic resource, IT mattered greatly. One of Carr's main points was that the level of corporate investment in IT needed to be considered strategically and according to whether each particular IT solution was more properly considered a secondary activity or if it added value as a strategic resource that could provide a strategic advantage.

Since it is difficult in a free market to obtain and keep a sustainable competitive advantage (Porter, 1980) when an organization can obtain a strategic resource through the usage of IT they should usually invest in proprietary IT to increase their strategic flexibility by maintaining control of the software development (Agrawal, 2005a) if doing so will assist the organization in preserving rarity and imperfect imitability to the maximum extent possible. When an organization can't use IT as a strategic resource rivals can act as fast followers to develop and implement similar IT solutions



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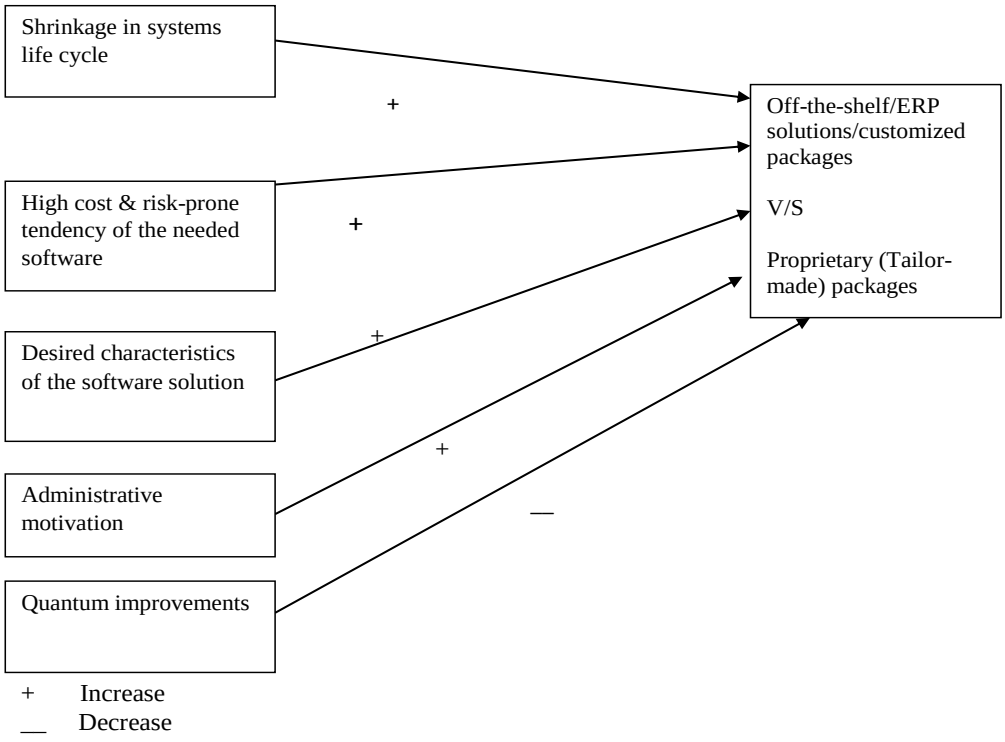
quickly. Wailgum (2007) uses Walmart, Dell, and Jet Blue as examples of organizations that have used proprietary software for competitive advantage. But that advantage has faded or disappeared for these and many other companies. As the quality of COTS products has increased across most domains the comparative differences between COTS and proprietary applications has been greatly reduced, in many cases to the point that COTS can not only serve as an effective substitute to even very good proprietary systems but the COTS product can usually do so at a fraction of the cost. Companies such as Walmart were innovators in building IT applications to support business processes that were best practices. But given the IT business environment that they now operate in, they continue to build custom applications where it makes sense from a strategic perspective but they have started to increasingly use commercial applications for business intelligence and other infrastructural needs (Wailgum, 2007).

**Figure 1: Conceptual Model – Strategic Issues in Development of Software: Source Agrawal (2005a, p. 24).**




Four major trends leading to decreased usage of proprietary software are faster development time (shrinkage in systems life cycle), more complex projects (high cost and risk-prone tendency of the needed software), ease of use and predictability (desired characteristics of the software solution), and the desire of senior management to avoid risks and to focus on core competencies (administrative motivation) (Agrawal 2005a).

**Table 1: Measuring Parameters with Identified Variables (Agrawal, 2005a).**

| Item | Variable | Questions for Measurement |
|---|---|---|
| B3a. | Shrinkage in Systems Life Cycle | Time compression |
| B3b. | | Shorter obsolescence cycle of packages. |
| B3i. | | Higher rate of upgrades in hardware/software. |
| B3c. | High Cost and High Risk Prone Tendency of the needed Software | High failure rate of packages. |
| B3d. | | Cost of development of packages. |
| B3e. | | Complexity of required application packages. |
| B3g. | Desired Characteristics of the Software Solution | The packages have in-built best practices followed in the industry |
| B3h | | Ease of training |
| B3k. | | The packages can help in implementation of Just-in-Time/ Total-Quality-Management/Business Process Reengineering. |
| B3l. | | The packages are proven for reliability. |
| B3n. | | Little maintenance problem in the packages. |
| B3f. | Administrative Motivation | Non-availability of manpower in information technology |
| B3j. | | Organizations prefer to change their processes due to advantages in using the packages. |
| B3m. | | Availability of skilled End Users to operate the packages. |
| B3o. | | Availability of reliable software maintenance support. |
| B3q. | | Packages are critical to the operation of the organization. |
| B3p. | Quantum Improvement | Flexibility available in the software packages. |
| B3r. | | Control of the entire life cycle of the package. |
| B3s. | | Packages enable automation of firm specific processes |

These factors serve to make proprietary software development riskier and of decreased incremental value than was traditionally the case in comparison to COTS. This is hypothesized to lead to an overall decrease in usage of proprietary software as organizations shift usage to COTS application. One exception is when a new solution, or a radical change to existing IT application, is introduced and greatly improves existing business practices in such a way as to provide a sustainable competitive advantage (quantum improvements). Organizations seeking to use quantum improvements to achieve a strategic advantage are hypothesized to be more likely to attempt to do so through the usage of proprietary software because using a COTS product might be valuable but using a COTS application would all but prohibit any possibility of a resource being rare and imperfectly imitable even if the COTS resource was valuable and non-substitutable. The impact of each of the trends above will be considered in relation to how it affects the percentage of applications moving to COTS (and conversely, away from proprietary software).



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## COMMERCIAL-OFF-THE-SHELF SOFTWARE

### *The systems life cycle is shrinking*

The number of organizations competing and the number of workers employed by those organizations has been growing. The growth is characterized by an increased level of international business and a systems life cycle that continues to shrink as formal software development methodologies and other improvements occur. The environment is rapidly changing, turbulent, and unpredictable (Applegate et al., 2009, Scott-Morton, 1991; Turban & Volonino, 2011). Time-compression, short product life cycles, discontinuity of strategies, an increased need for in depth knowledge, and an approach that focuses on the customer are common in the current IT environment. (El Sawy, Malhotra, Gosain, & Young, 1999). In addition to, and at least partially because of, these factors packages will also be costlier because of faster obsolescence. Many businesses now compete on the basis of time (Li & Ye, 1999) further added to the pressure on IT systems. Changes in strategy will have to occur more frequently because of the pace of business enabled largely by IT and these changes will lead to still more alterations in processes and subsequent changes to the supporting software. The accelerated changes in technology leads to software firms having very short development time cycles (Matheson & Tarjan, 1998; Nidumolu & Knotts,1998). Naukam (2014) asserted that the business users are not satisfied with the backlog of projects and performance of IT department. Commercial Off the Shelf ERP systems are expected to experience increased adoption because of the resulting higher rate of obsolescence Agrawal (2005b). Largely because of the IT environment described above most organizations will strive to reduce the amount of time and money invested in IT software development by utilizing COTS, cloud computing, software as a service, COTS/ERP, and other solutions to decrease the expense and risk of developing proprietary software (Agrawal et al. 2011).

> **Hypothesis 1:** The mean "Systems life cycle shrinkage" score for managers who are anticipating increased usage of COTS/ERP in the next 5 years will be different than the mean "Systems life cycle shrinkage" score for managers who do not anticipate increased usage of COTS/ERP in the next 5 years.

### *High cost and risk-prone tendency of the needed software*

IT outsourcing has grown because of three primary reasons 1.) companies increasingly want to concentrate on their core competencies so they outsource areas such as technologies and IT components when those are not core competencies; 2.) officer dissatisfaction with the information systems department's performance; 3.) outsourcing is more cost effective (Lucas, 2000; Turban, McLean, & Whetherbe, 2001; Turner & Kambil, 1994; Venkatraman & Short, 1992).

Purely technical IT tasks, such as change management and implementation, were projected to not be good candidates for outsources but the rest of the organizational IT functions, such as coding, are good candidates to outsource in order to reduce IT expenses (Markus & Benjamin,1996). Palvia and Wang (1995) found that outsourcing and downsizing was being considered by many IS executives to improve their IT Department's performance. Software development is expensive and risky due to the complexity of modern systems and high project failure rates are common. A report by Standish Group 2015 Chaos Report on the success of software projects reveals that during year

2015 in the United States 29% of all projects succeeded (delivered on time, on budget, with required features and functions), 52% were challenged (late, over budget, and/or with less than the required features and functions), and 19% failed (cancelled prior to completion or delivered and never used). Furthermore, estimated success of large-scale (large and grand) software development (projects with more than $10 million in labor content) stated that 10.5% of all projects succeeded, 57% were challenged, and 32.5% failed (Hastie & Wojewoda, 2015).

Complex systems are more likely to fail as are integrated systems since development of integrated systems tends to be both complex and large (Jeong & Klein, 1999). Software development productivity has increased because of improvements in code reusability and customizability resulting from the object oriented approach and this has led to increased flexibility, increased predictability, and fewer errors (Nidumolu & Knotts, 1998). However fast obsolescence rate combined with high cost and risk factors will continue to make in-house development less desirable for complex projects if the functionality required is available in a COTS alternative. With the shift of the role of information technology toward a strategic necessity approach (Carr, 2013, 2003), reduced investments on IT applications will be preferred when requirements can be met by a COTS product at a significantly lower cost.

> **Hypothesis H2:** The mean "Higher development cost and risks associated with the development of proprietary software" score for managers who are anticipating increased usage of COTS/ERP in the next 5 years will be different than the mean "Higher development cost and risks associated with the development of proprietary software" score for managers who do not anticipate increased usage of COTS/ERP in the next 5 years.

### *Desired characteristics of software*

Ease of use and predictability of cost and outcome are desired characteristics of software that favor COTS/ERP. Davis (1986) found that ease of use and usefulness predict user intention to use a technology. Many COTS products now offer a standardized user interface that helps end users learn how to use similar products quicker than would have previously been possible. In order to reduce training costs and improve user satisfaction firms want software that is easy to use. A simpler user interface and improved artificial intelligence are factors that are leading many COTS systems to be usable with little or no training. Reliable predictions of costs of acquisition, implementation, and use or off-the-shelf/ERP solutions can be determined with some precision (Heikkilä, Saarinen, & Sääksjärvi, 1991; Laudon and Laudon, 2015) but as mentioned in the preceding section, the development of proprietary systems is subject to cost overruns, budget delays, and an uncertain ability to meet the expectations of the users (Hastie & Wojewoda, 2015). To avoid some of the risk factors mentioned earlier firms want predictability. Furthermore, COTS packages are immediately available and can save up to 50% or more compared to the costs of development efforts. In addition, organizations can reduce maintenance costs by implementing COTS/ERP packages. As much as 80% of a corporations' IT budget can be dedicated to maintenance costs of in-house developed proprietary packages (Turban et al. 2011). With the



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installation of a new application such as a COTS/ERP allows them to upgrade their processes using best practices built into the packages (Turban et al., 2001).

> **Hypothesis H3:** Managers with a higher mean score on the "desired characteristics of software" construct who are anticipating increased usage of COTS/ERP in the next 5 years will be different than the mean ""desired characteristics of software" construct" score for managers who do not anticipate increased usage of COTS/ERP in the next 5 years.

### *Administrative motivation*

As many of the IT functions that would previously have been addressed by the information systems department have been decentralized to the end users the manpower and budget has to accomplish those functions has also gone to the end user and the manpower and budget allocated to information systems departments has been decreasing (Edberg and Bowman, 1996; He, Kusy, & Zhao, 1998; Lucas, 2000). This shift is largely driven by an increased availability of user-friendly software, knowledgeable end-users, and extensive company support to EUC (Turban et al., 2001). End-users are assuming increased responsibilities for information systems applications, and end-user involvement is positively correlated with the success of information systems (Doll and Torkzaddah, 1988; McLean, Kappelman, & Thompson, 1993; Winter, Chudoba, & Gutek, 1997). Turban et al. (2001) claimed that many of the user requirements are smaller in size and can be developed by end-users themselves. The percentage of knowledge and information work constitutes 60% of America's GNP and 55% in America's labor force (Laudon and Laudon, 1999). As more knowledge workers are available and the have tools with simple user interfaces for daily work and application development tools/utility programs end users may develop most smaller one-time application software with no or minimal assistance from IT professionals (Agrawal et al. 2011). Many of the previously mentioned factors also serve as administrative motivation for moving to COTS. Administrative motivation reasons also include the continuing growth in software and the outsourcing market that can be attributed to the shifting role of IT as a commodity due to the reliability of services provided by these sources (Carr 2003, 2013). Because management is not satisfied with the performance of IT departments they are replacing in-house development with COTS (Naukam 2014). In order for organizations to survive in an increasingly more competitive environment they have to consider the usage of COTS or outsourcing where appropriate.

> **Hypothesis H4:** Managers with a higher mean score on the "administrative motivation, system performance" construct who are anticipating increased usage of COTS/ERP in the next 5 years will have a statistically significant different score than the mean



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"administrative motivation, system performance" construct score for managers who do not anticipate increased usage of COTS/ERP in the next 5 years.

***Continuous improvements/quantum improvements***

Intense competition leads to uncertainty and stimulates higher innovation and adoption rates that will, in turn, increase competition (Ettlie, 1983; Lewin, Lewin, & Meisel, 1987). Supernormal profits are not sustainable in a competitive market with free entry (Porter, 1980).

Short-term profits are possible but over time the profit earned will equal the cost of capital plus compensation to the owner for unique inputs to production. When secrecy is maintained IT can provide a short-term competitive advantage but duplication time for applications is months at most in many cases and rapidly developed new innovations will make the old ones obsolete (Porter, 1996; Turban et al., 2015). In light of this, IT in unlikely to be a source for gaining a competitive advantage in most cases. IT has been identified as mostly a commodity or a strategic necessity for the organization and cannot be a source of sustainable competitive advantage (Brynjolfsson, 1996; Carr 2003, 2013; Clemons 1990, 1991; Clemons and Kimbrough, 1986; Emery, 1990; Kermer and Sosa, 1991; McNurlin, 1991). In the industrial world most businesses could not function without computers and software (Jones, 1994). As IT's role as a strategic necessity to obtain a competitive advantage decreases the level of corporate investment in IT will be decreased as well for most organizations (Carr 2003, 2013). Organizations will minimize their application packages expenses by using COTS/ERP solutions with a policy of continuous improvements. Alternatively, when organizations have a possibility of establishing a sustainable strategic advantage they will develop proprietary application packages in order to maintaining control of the software development and the flexibility in the packages even though the expense involved will be greater.

**Hypothesis H5:** Managers with a higher mean score on the "importance of quantum improvement" construct who are anticipating increased usage of COTS/ERP in the next 5 years will have a statistically significant different score than the mean "the importance of quantum improvement" construct score for managers who do not anticipate increased usage of COTS/ERP in the next 5 years.

## MEASURES

For the constructs the measures were based upon prior available literature (Table 1), validated, and adapted to the context of this study. Multiple-item measures were used for assessing the various research constructs. All the items were measured using a seven-point Likert type scale. Details of the process are given in section 5, "Implementation of Research Methodology."

## METHODOLOGY

The scope of study for this research project is the manufacturing and service sectors for United States based organizations. This study has been defined as exploratory and descriptive. A

"survey" approach was used to achieve more generalizability and additional richness. The study is divided into three phases:

> ***Phase 1 – Exploratory study***: In this phase a literature search was conducted and the findings were analyzed. Based upon the results of that analysis the problem list and a revised version of Agrawal's questionnaire (Agrawal, 2005a) were developed.
>
> ***Phase 2 – Survey and construct validity***: In this phase, a questionnaire survey was used to answer the research questions. For testing the construct validity of the questionnaire, a principal component factor analysis, combined with Varimax rotation, was performed.
>
> ***Phase 3 – Data analyses:*** The data are quantitative in nature. The data were used to test the hypotheses using t-test, and correlation.

## IMPLEMENTATION OF RESEARCH METHODOLOGY

This section is divided into six sub-sections: questionnaire design, questionnaire validation, reliability using Cronbach's Alpha, questionnaire testing, administering the instrument, and profile of responding firms and respondents.

### *Questionnaire design*

The questionnaire uses the Likert scale with seven intervals, from low to high, with equal weights. Because of the difficulties in measurement, open-ended questions were avoided.

### *Questionnaire validation*

The questionnaire validation exercise was divided into four parts: face validity, criterion-related validity, content validity, and construct validity.

#### *Face validity*

The variables and items developed by Agrawal (2005a) were used for initial development of the questionnaire. This study's authors discussed and agreed upon a revised set of variable attributes with agreed upon wording to describe each attribute. The wording of each attribute's description was used as an item to describe the over-all constructs being studied. The construct each item on the questionnaire was hypothesized to represent was validated and refined using the following process. Three professors served as judges and independently specified which construct, if any, each item represented. The perceptions were then compared. If all judges agreed on which construct the item represented the item was considered to have acceptable face validity. Where there was disagreement the judges discussed the meaning of the question to make sure each judge had the same understanding of the meaning. If the disagreement of the judges was not with the wording of the question but rather with the meaning the question was considered to not be a good item to measure the underlying construct the item was meant to measure and the question was



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discarded. Where the meaning of the question was perceived differently the question was reworded to clarify the meaning and the judges independently evaluated each item again.

This process continued until all three judges agreed on which underlying construct the item would measure or the meaning of the question was clearly understood but there was still disagreement on the suitability of that question to serve as an item to measure a particular construct, in which case that item was discarded. The idea was to bring out the mental image for the variables in acceptable language. This exercise helped in evolving operational definitions of variables and in modifying the language of the questions. Once the items had face validity they were operationalized through the questionnaire.

*Criterion-related validity*

This helped in understanding the questionnaire, its objective, purpose, language, context, and feasibility of answering from the respondent's point of view. Four IS executives from different firms were involved in this exercise, which helped in making the questions more specific. Based on their experience, the execut executives commented on the wordings, size and time required to respond and suggested several major changes. Items changed as a result of this process were then reexamined for face validity.

*Content validity*

A document containing the objective of the study and operational definitions of the variables and the questionnaire was supplied to four professors and three IS executives. The judges were to indicate which questions measured which variables. The questions which scored less than 70 percent agreement were modified. After correcting the questionnaire, the judges helped in resequencing the questions so they represented the logical relationship of variables and natural flow of thoughts.

*Construct validity*

Prior to the extraction of the factors, several tests were used to assess the suitability of the respondent data for factor analysis. These tests included Kaiser-Meyer-Olkin (KMO) Measure of Sampling Accuracy (Kaiser, 1970, Kaiser and Little Jiffy, 1974), Correlation Analysis (Kim and Mueller, 1978), and Bartlett's Test of Sphericity (Bartlett, 1950). SPSS version 23.0 was used for all data analysis conducted in this study. The KMO index, in particular, is recommended when the cases to variable ratio are less than 1:5. The KMO index ranges from 0 to 1, with 0.5 considered suitable for factor analysis (Hair, Anderson, Tatham, Black. 1995, Tabachnick and Fidell, 2007). When analyzing the correlations of the items only items with a correlation of .4 and above should be retained for factor analysis (Kim and Mueller, 1978). All items were correlated with all other items at greater than the .4 level with .437 being the lowest correlation between any two items. The Bartlett's Test of Sphericity should be significant ($p<0.05$) for factor analysis to be suitable (Hair et al., 1995, Tabachnick and Fidell 2007). For the data used in this study, the KMO index is



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0.934 and Bartlett's Test of Sphericity has a significance level p = 0.000 (Table 2), therefore the respondents' data are suitable for factor analysis.

**Table 2: Measurement of Sampling Adequacy Using KMO and Bartlett's Test of Sphericity**

| | | |
|---|---|---|
| Kaiser-Meyer-Olkin Measure of Sampling Adequacy. | | .934 |
| Bartlett's Test of Sphericity | Approx. Chi-Square | 2530.010 |
| | Df | 190 |
| | Sig. | .000 |

In order to determine the number of factors for each construct an eigenvalue greater than one rule is recommended for established instruments (Churchill, 1979). For exploratory analysis the selection of the number of factors is determined using both the underlying theory used to develop the instrument and on empirical results (Hinkin, Tracey, & Enz, 1997). Six factors were used for factor analysis in this study to test the theory-based proposed 5 factor model. Factor analysis was also conducted with 4, 5, and 7 factors to test for the possibility that the items might better conform to a different factor structure. Of the models tested, the 6 factor model fit the best. Loadings greater than 0.40 in absolute value are suggested as the criterion for significant factor loadings (Ford, MacCallum, & Tait , 1986) and all items load in excess of 0.4 (Table 5). The items employed in this study to assess factors influencing the trend in requirements of categories of application software was a 20-item evaluation of all samples in manufacturing and service sectors of the United States. A principal components factor analysis of the evaluation scale was conducted using the 148 valid responses collected. Factor analysis can obtain an accurate solution with a sample size of 150 observations or more if intercorrelations are reasonably strong (Guadagnoli and Velicer, 1988) so the sample size is considered adequate. The questionnaire items generally loaded under the variables they sought to measure (Table 3). In some cases, items loaded on a construct different from the one hypothesized by the research review conducted in the paper.



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| Table 3: The Modified Constructs with Measuring Data Items. | | |
|---|---|---|
| **Item** | **Variable** | **Questions for Measurement** |
| 13 | Desired Characteristics of the Software Solution (Factor 1) | Availability of skilled End Users to operate the packages. |
| 14 | | Reduced maintenance problems in the packages |
| 15 | | Availability of reliable software maintenance support. |
| 16 | | Flexibility available in the software packages |
| 17 | | Packages are critical to the operation of the organization. |
| 19 | | Packages enable automation of firm specific processes |
| 21 | | The packages can help in implementation of Just-in-Time/ Total-Quality-Management/Business Process Reengineering. |
| 1 | Shrinkage in Systems Life Cycle (Factor 2) | Rapid changes in the business cycle. |
| 2 | | Applications are becoming obsolete quickly |
| 3 | | High failure rate of packages during development |
| 9 | Administrative Motivation, System Performance (Factor 3) | Faster upgrades in hardware/software |
| 10 | | Organizations prefer to change processes to gain advantages using packages |
| 12 | | The packages are proven for better reliability |
| 20 | | Availability of a user community |
| 6 | Administrative Motivation, HR (Factor 4) | Shortage of information technology professionals |
| 7 | | The packages have in-built best practices followed in the industry |
| 8 | | Ease of training |
| 4 | High Cost and High Risk Prone Tendency of the needed Software (Factor 5) | Cost of development of packages |
| 5 | | Complexity of required application packages. |
| 18 | Quantum Improvement (Factor 6) | Control of the entire life cycle of the package |

If the item had more than a .2 difference it was used to measure the construct it loaded on the highest. Some items loaded on more than one factor but every item loaded on at least one factor at a significant level. Some possible reasons for the cross loadings are discussed in the "limitations" section of this paper.

Six distinct factors were used. The Eigenvalues and variance explained by each factor are presented in Table 4. The 7-item factor of desired characteristics of the software solution explained the majority of the scale variance, followed by 4-item factor administrative motivation, system performance, 3-item factor shrinkage in systems life cycle, and 3-factor administrative motivation, HR. The high-cost and risk prone tendency of needed software explained by the 2-item factor and the sixth factor quantum improvement by one-item. The factors emerged as anticipated, given a

subjective knowledge of the participants' responses. The summary of constructs and factor loadings are narrated in Table 4 and Table 5 respectively.

**Table 4. Factor Analysis – Loading and Variances in the Identified Factors**

| Factor | Items | Eigenvalue | % of Variance |
|---|---|---|---|
| Desired Characteristics of the software solution (Factor 1) | 7 | 11.940 | 59.702 |
| Shrinkage in systems life cycle (Factor 2) | 3 | 1.064 | 5.319 |
| Administrative motivation 1 (Factor 3) | 4 | 0.972 | 4.858 |
| Administrative motivation 2 (Factor 4) | 3 | 0.870 | 4.349 |
| High cost and risk prone tendency of the needed software (Factor 5) | 2 | 0.645 | 3.225 |
| Quantum Improvement (Factor 6) | 1 | 0.601 | 3.007 |

"

"Desired characteristics of the software solution" was the label given to the first factor. Thi s 7-item dimension explained the most variance of the five emergent factors (59.702%). Example items include: "availability of skilled End Users to operate the packages," and "reduced maintenance problems in the packages." The second factor "shrinkage in systems life cycle" contains items such as "rapid changes in the business cycle," "applications are becoming obsolete quickly," and "high failure rate of packages during development." The high failure rate of packages during development," which was proposed under "High cost and high risk prone tendency of the needed software," loaded strongly on "shrinkage in systems life cycle." This is possibly because the shrinkage in the system life cycle is associated with a higher failure rate for ERP and is thus an important consideration when considering the acquisition of a new software application. The proposed factor "administrative motivation" is split into two factors: administrative motivation, system performance and administrative motivation, HR, which contain items such as "the packages have in-built best practices followed in the industry," "ease of training," and "faster upgrades in hardware/software." The faster upgrades of hardware/software classified under administrative motivation may be because of this feature. With the shift to COTS solutions customers have come to expect each organization to provide all of the latest features. For example, if one organization in an industry offers the ability to track packages customers expect that all organization in that industry will be able to track packages. Organizations not using IT for a competitive advantage can more easily introduce capabilities made possible with newer versions of software at a rapid pace using COTS/ERP packages. This would likely not apply to companies such as Facebook, Netflix, Amazon, and others that use their information systems as a core part of their business strategy. Furthermore, fourth factor "high cost and risk prone tendency of the needed software" contain the items "cost of development of packages" and "complexity of required application packages." These questions were also identified with the same variables by Agrawal (2005a). A sixth factor "quantum improvement" is associated with only one item "control of the entire life cycle of the package."



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| **Table 5: Loading of Data Items on the Factors Rotated Component Matrix[a]** | | | | | | |
|---|---|---|---|---|---|---|
| | **Component** | | | | | |
| | 1 | 2 | 3 | 4 | 5 | 6 |
| B3_1 | .249 | .800 | .235 | .226 | .083 | .124 |
| B3_2 | .420 | .659 | .218 | -.043 | .279 | .145 |
| B3_3 | .315 | .586 | .146 | .353 | .295 | .113 |
| B3_4 | .254 | .272 | .068 | .100 | .830 | .159 |
| B3_5 | .213 | .151 | .297 | .389 | .705 | .095 |
| B3_6 | .304 | .288 | .061 | .784 | .254 | -.008 |
| B3_7 | .297 | .189 | .493 | .596 | .188 | .241 |
| B3_8 | .285 | .166 | .484 | .563 | .068 | .407 |
| B3_9 | .115 | .393 | .675 | .035 | .295 | .391 |
| B3_10 | .490 | .264 | .671 | .249 | .103 | .001 |
| B3_12 | .579 | .292 | .614 | .183 | .126 | -.049 |
| B3_13 | .757 | .260 | .207 | .155 | .311 | -.123 |
| B3_14 | .741 | .227 | .104 | .204 | .197 | .212 |
| B3_15 | .755 | .250 | .203 | .277 | .176 | .198 |
| B3_16 | .639 | .252 | .359 | .310 | .143 | .294 |
| B3_17 | .714 | .261 | .223 | .165 | .100 | .345 |
| B3_18 | .364 | .395 | .140 | .142 | .305 | .626 |
| B3_19 | .470 | .463 | .255 | .312 | .195 | .345 |
| B3_20 | .173 | .596 | .433 | .363 | .212 | .134 |
| B3_21 | .410 | .575 | .189 | .308 | .255 | .301 |
| Extraction Method: Principal Component Analysis.<br>Rotation Method: Varimax with Kaiser Normalization.[a] | | | | | | |
| a. Rotation converged in 12 iterations.<br>Factor 1 = Desired Characteristics of the Software Solution<br>Factor 2 = Administrative Motivation<br>Factor 3 = System Performance<br>Factor 4 = Administrative Motivation, HR<br>Factor 5 = High Cost and High Risk Prone Tendency of the needed Software<br>Factor 6 = Quantum Improvement | | | | | | |

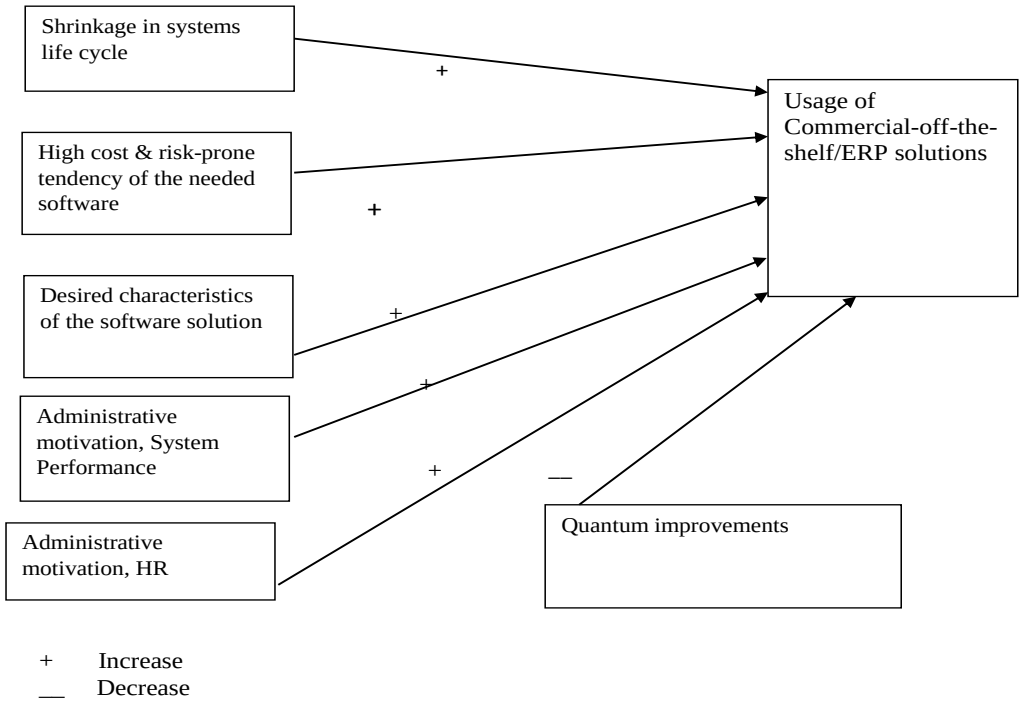
Based on the results of the exploratory factor analysis an additional hypothesis for the new construct developed and is reflected in a revised model (Figure 2).

> **Hypothesis H6:** Managers with a higher mean score on the "administrative motivation (HR)" construct who are anticipating increased usage of COTS/ERP in the next 5 years will have a statistically significant different score than the mean "administrative motivation (HR)" construct score for managers who do not anticipate increased usage of COTS/ERP in the next 5 years.

Based on the constructs identified, the model is revised and shown in Figure 2 which is considered uniformly to facilitate the needed analysis of responses from organizations in the United States. In

spite of seeming limitations, this provides confidence that the questionnaire administered had enough construct validity.

**Figure 2: Modified Conceptual Model – Strategic Issues in Development of Software.**




***Reliability using Cronbach's Alpha:*** Cronbach's Alpha Was used to estimate the reliability of a scale. An increase in the correlation between items will result in an increase in the value of Cronbach's Alpha. Table 6 shows the results of a reliability analysis conducted using Cronbach's Alpha.

**Table 6. Reliability Analysis**

| | | Cronbach's Alpha |
|---|---|---|
| Factor | Items | COTS Software |
| Desired Characteristics of the software solution (Factor 1) | 7 | 0.937 |
| Shrinkage in systems life cycle (Factor 2) | 3 | 0.830 |
| Administrative motivation, system performance (Factor 3) | 4 | 0.873 |
| Administrative motivation, HR (Factor 4) | 3 | 0.850 |
| High cost and risk prone tendency of the needed software (Factor 5) | 2 | 0.774 |
| Quantum Improvement (Factor 6) | 1 | Single Item |

Five of the six factors had alpha reliabilities that were within the traditionally acceptable range of above 0.70 (Nunnally, 1970). The factor quantum improvement is explained by one-item and therefore its alpha reliability could not be calculated.

*Questionnaire testing*

The questionnaire was tested with the help of four professors and three IS executives. The respondents were encouraged to identify difficulties in completing the questionnaire. Complaints regarding the format, length, language, and context of some of the statements were noted and the questionnaire was redesigned.

***Administering the instrument***

The questionnaire survey was administered following the guidelines suggested by Dillman (1978, 2000). The targeted sample was of IT professionals with some responsibility for making IT software acquisition decisions for organizations based in the United States. The survey instrument was operationalized electronically using the fees-based non-probability internet panel service from Qualtrics. Blankenship, Breen, and Dutka (1998) indicated that online panels were lower cost, faster response, and had the ability to obtain a targeted sample of people who are scarce in the general population.

The questionnaire survey was sent to a panel of senior managerial IT professionals (directors, chief information officers, middle managers, etc.) of firms in the United States. All recipients of the invitation were selected from among those who have registered to participate in Qualtrics online surveys and polls. The data have not been weighted to reflect demographic composition of IT professionals and no demographic analysis is conducted. In order to participate subjects were required to read and accept the institutional review board (IRB) statement and to select a qualifying description of the management position they served in. If anyone opted out of the survey after reading the IRB statement or if they indicated they were not in an appropriate job function to participate, the survey terminated before advancing to the research questions. In order to have adequate representation for analysis in each industry type, target quotas of 80 service sector responses and 70 manufacturing sector responses were established. The service sector industry type had a further target quota of 40 respondents in the Computer Software industry sector and 40 respondents for other service industry sectors. Once a quota was reached Qualtrics deactivated the links given in the invitation to participate for that sector. The deactivated links were based upon the industry each person's panel profile indicated they worked in. Because respondents were paid only if they completed the survey the quota results were not exact. Respondents who had changed industry or who began a survey before the link was deactivated were allowed to finish the survey..

Out of the 153 questionnaires started, the total usable responses were 148. According to Callegaro and DiSogra (2008) calculating a response rate for non-probability samples is not meaningful because determining the denominator is not possible. This resulted in a break-off rate of 96.73 percent, indicating that subjects who started the survey were very likely to fully or partially complete the survey. Because the sample is based on those who initially self-selected for participation rather than a probability sample, no estimates of sampling error can be calculated. All sample surveys and polls may be subject to multiple sources of error, including but not limited to sampling error, coverage error, and measurement error (Baker, et al., 2010).



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*Profile of responding firms and respondents*

This section is divided into three parts: industry type, organization size, and respondent profile.

*Industry type*

47% of the respondents (Table 7) were from the manufacturing sector and 53% from the service sector. Respondents from manufacturing and computer software/technology were relatively higher compared to other industries in both sectors.

*Organization size*

About 41 percent of respondents (Table 8) were from medium and large organizations having annual sales of above $250 million. The remaining respondents were from smaller size organizations. The respondents were approximately in equal proportion in the organizations above and below $250 million in the United States.

*Respondent profile:* The perception about issues related to IT (Tables 9 and 10) seems to have a fair representation based on the respondent's profile in the organization. 79% of the respondents are from information systems departments, as intended for this survey research. The remaining respondents were directly associated with the information systems department. The largest proportion of respondents were from senior level management. In most of the respondents' organizations the fulltime information systems' employees were 100 or higher having IT department's budget more than $10 million.



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| **Table 7: Distribution of Types of Industries in the Sample.** | | |
|---|---|---|
| What is the primary industry of your host organization | Responses | Percentage |
| Manufacturing Sector | | |
| Automobile Manufacturing | 1 | 1% |
| Computer Hardware | 17 | 11% |
| Manufacturing | 47 | 32% |
| Pharmaceutical Manufacturing | 2 | 1% |
| Telecommunications Hardware | 1 | 1% |
| Other Manufacturing | 0 | 0% |
| --Aerospace | 1 | 1% |
| --Pl | 1 | 1% |
| Total Manufacturing Sector | 70 | 47% |
| Service Sector | | |
| Computer Software | 36r | 25% |
| Technology | 21 | 14% |
| Construction | 3 | 2% |
| Government | 3 | 2% |
| Healthcare | 2 | 1% |
| Insurance | 2 | 1% |
| Banking | 3 | 2% |
| Retail | 1 | 1% |
| Transportation | 3 | 2% |
| Utilities | 1 | 1% |
| Other | | |
| -- Consumer | 1 | 1% |
| -- Accounting Firm | 1 | 1% |
| -- Engine | 1 | 1% |
| **Total Service Sector** | **78** | **53%** |
| **Total of Both Sectors** | **148** | **100%** |

| **Table 8: Size of the Organizations in the Sample.** | | |
|---|---|---|
| What is the annual sales of your host organization | Number of Responses | Percentage |
| Up to 5 million | 8 | 5% |
| 5 million to 20 million | 28 | 19% |
| 20 million to 50 million | 22 | 15% |
| 50 million to 250 million | 29 | 20% |
| 250 million to 500 million | 14 | 9% |
| 500 million to 1 billion | 24 | 16% |
| 1 billion to 2 billion | 13 | 9% |
| More than 2 billion | 10 | 7% |
| Total | 148 | 100% |



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| Table 9: Level of Respondents in the Organizations and their Functional Departments. | | | | | |
|---|---|---|---|---|---|
| What is your level in the organization | Responses | % | Functional department | Responses | % |
| Executive | 53 | 36% | Accounting | 4 | 3% |
| Directors | 35 | 23% | Administration | 9 | 6% |
| First Line Management | 28 | 19% | Engineering | 12 | 8% |
| Middle Management | 32 | 22% | Information Systems | 116 | 79% |
| | | | Production | 1 | 1% |
| | | | Sales/Marketing | 4 | 3% |
| | | | Other | | |
| | | | --Purchasing | 1 | 1% |
| | | | --Development/Support | 1 | 1% |
| | 148 | 100% | | 148 | 100% |

| Table 10: Number of Full-time Employees and IT Budget. | | | | | |
|---|---|---|---|---|---|
| Full-time information systems' employee in your organization | No. of responses | % | Budget of organization's IT Department | No. of responses | % |
| 1 to 25 | 16 | 11% | Up to 10 million | 57 | 39% |
| 26 to 100 | 19 | 13% | 10 million to 25 million | 35 | 23% |
| 101 to 500 | 38 | 26% | 25 million to 50 million | 40 | 27% |
| 501 to 1,000 | 34 | 23% | More than 50 million | 16 | 11% |
| 1,000 to 2,000 | 26 | 17% | | | |
| More than 2,000 | 15 | 10% | | | |
| | 148 | 100% | | 148 | 100% |

## DATA PROCESSING AND RESULTS

The results of statistical analysis are presented to show the degree of association among the variables and to examine the statistical significance of the model presented. The significance levels of 0.01 and 0.05 are very common in research. In the case of this study we considered 0.05 to be appropriate since the research is exploratory in nature. The software package used for all of the statistical analysis in this paper were done using SPSS version 23.00.

This part is divided into five sub-parts: descriptive statistics, ranking of variables and data items, trends in usage of category of software packages, analysis and validation of major hypothesis, contributing factors to support the trends in IT outsourcing/offshoring.

**Table 11: Descriptive Statistics of Variables.**

| | Range | Mean | | Std. Deviation | Variance | Skewness | | Kurtosis | |
|---|---|---|---|---|---|---|---|---|---|
| | Statistic | Statistic | Std. Error | Statistic | Statistic | Statistic | Std. Error | Statistic | Std. Error |
| C.Usage of Off-the-shelf, Non-ERP Software | 100 | 25.31 | 1.820 | 22.136 | 489.984 | 1.770 | .199 | 3.740 | .396 |
| C.Usage of Proprietary, Non-ERP Software | 100 | 24.16 | 1.624 | 19.757 | 390.354 | 1.678 | .199 | 4.475 | .396 |
| C.Usage of Off-the-shelf, ERP Software | 100 | 24.96 | 1.787 | 21.740 | 472.638 | 1.584 | .199 | 3.440 | .396 |
| C. Usage of Proprietary, ERP Software | 100 | 25.57 | 1.791 | 21.784 | 474.546 | 1.164 | .199 | 1.869 | .396 |
| F.Usage of Off-the-shelf, Non-ERP Software | 100 | 24.37 | 1.610 | 19.593 | 383.868 | 1.638 | .199 | 4.617 | .396 |
| F.Usage of Proprietary, Non-ERP Software | 100 | 25.74 | 1.749 | 21.282 | 452.944 | 1.697 | .199 | 4.187 | .396 |
| F.Usage of Off-the-shelf, ERP Software | 100 | 24.77 | 1.822 | 22.169 | 491.484 | 1.641 | .199 | 3.599 | .396 |
| F. Usage of Proprietary, ERP Software | 100 | 25.12 | 1.952 | 23.752 | 564.148 | 1.427 | .199 | 2.068 | .396 |
| Change in Usage of COTS over 5 Years | 170.0 | -1.128 | 1.6755 | 20.3832 | 415.473 | -1.974 | .199 | 10.086 | .396 |
| Change in Usage of Proprietary Software over 5 Years | 170.0 | 1.128 | 1.6755 | 20.3832 | 415.473 | 1.974 | .199 | 10.086 | .396 |
| COTS.Desired Characteristics of Software Solution (Factor 1) | 6.0 | 5.036 | .105 | 1.28 | 1.627 | -1.315 | .199 | 1.844 | .396 |
| COTS.Shrinkage in Systems Life Cycle (Factor 2) | 6.0 | 4.82 | .111 | 1.354 | 1.834 | -.836 | .199 | .466 | .396 |
| COTS.Administrative Motivation, system performance (Factor 3) | 6.00 | 5.0169 | .10568 | 1.29 | 1.653 | -1.060 | .199 | 1.169 | .396 |
| COTS.Administrative Motivation, HR (Factor 4) | 6.0 | 4.865 | .1121 | 1.364 | 1.861 | -.919 | .199 | .708 | .396 |
| COTS.High Cost and Risk Prone Tendency of the Needed Software (Factor 5) | 6.0 | 5.020 | .1057 | 1.2856 | 1.653 | -.807 | .199 | 1.044 | .396 |
| COTS.Quantum Improvement (Factor 6) | 6.0 | 4.973 | .1126 | 1.3700 | 1.877 | -1.029 | .199 | 1.246 | .396 |



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| | | |
|---|---|---|
| Valid N (listwise) | 1<br>48 | Prefix C = Current (2016), Prefix F – Future (% years from 2015)<br>Prefix Prop. = Proprietary, COTS = Commercial-off-the-shelf |

***The Descriptive Statistics***

The descriptive statistics for factors hypothesized to influence the trends in usage of various categories of application software are tabulated in the Table 11. In the case of usage of COTS/ERP software, the respondents ranked the influencing variables, Desired Characteristics of Software Solution, Administrative motivation, system performance, and High Cost and Risk Prone Tendency of the Needed Software with mean values above 5 (slightly high) on a seven-point scale. The other three variables (Shrinkage in Systems Life Cycle, Administrative motivation, HR, and Quantum Improvement) ranked in the range of 4.8-4.9. The standard deviations ranges between 1.2 and 1.4 which seems very normal for a seven-point scale. Skewness is a measure of symmetry, or more precisely, the lack of symmetry. A distribution, or data set, is symmetric if it looks the same to the left and right of the center point. Kurtosis is a measure of whether the data are heavy-tailed or light-tailed relative to a normal distribution. The skewness for a normal distribution is zero, and any symmetric data should have a skewness near zero. Negative values for the skewness indicate data that are skewed left and positive values for the skewness indicate data that are skewed right. By skewed left, we mean that the left tail is long relative to the right tail. Similarly, skewed right means that the right tail is long relative to the left tail. All variables for COTS software were skewed negatively in the range of 0.8 to 1.3. The kurtosis for a standard normal distribution is three. In our case the values mostly ranged between 0.466 and 1.84. These statistics reveal that the distribution of our sample is not standard normal. However, the trends in usage of various categories of application software, the kurtosis were mostly in the range of 3 while the responses were right skewed valued between 1.1 and 1.7.

In order to designate respondents as COTS/ERP Growth, Zero Growth, or Proprietary Growth and to convert the data accordingly the follow process was used. A respondent's belief about their firm's intention to change the organizations percentage of applications could be determined by comparing the respondent's answer to the question about the organizations' current usage of COTS vs proprietary sources to their answer about anticipated usage of COTS vs proprietary sources in 5 years. A new attribute was calculated to indicate the preference for COTS or proprietary by taking the value of the response to the item asking about estimated usage percentage of COTS in 5 years then subtracting the estimated current usage percentage of COTS. So for example, if a respondent indicated that current usage was 40% COTS and 60% Proprietary but in 5 years the expected distribution would be 50% COTS and 50% Proprietary that respondent would have 10 as their value for the new attribute. Two acquisition methods were available to select from, COTS and proprietary, and the total usage had to equal 100 percent for the survey to advance. Once a value for COTS was determined the value for Proprietary was simple the opposite of the COTS value. If the percent usage 5 years from now and current usage were the same the respondent's belief was that there would be zero change. This not only allows each response to be classified as COTS or Proprietary it also provided a measure of the degree of change the respondent thought would occur.

| Table 12: Ranking of Data Items and Variables. | | | |
|---|---|---|---|
| **Items** | **Data Item** | **Mean** | **Rank** |
| 21 | The packages can help in implementation of Just-in-Time/ Total-Quality-Management/Business Process Reengineering. | 5.149 | 1 |
| 9 | Faster upgrades in hardware/software | 5.115 | 2 |
| 15 | Availability of reliable software maintenance support. | 5.115 | 2 |
| 17 | Packages are critical to the operation of the organization. | 5.108 | 4 |
| 4 | Cost of development of packages | 5.054 | 5 |
| 14 | Reduced maintenance problems in the packages | 5.054 | 5 |
| 12 | The packages are proven for better reliability | 5.047 | 7 |
| 7 | The packages have in-built best practices followed in the industry | 5.014 | 8 |
| 5 | Complexity of required application packages. | 4.986 | 9 |
| 20 | Availability of a user community | 4.986 | 9 |
| 18 | Control of the entire life cycle of the package | 4.973 | 11 |
| 19 | Packages enable automation of firm specific processes | 4.973 | 11 |
| 2 | Applications are becoming obsolete quickly | 4.959 | 13 |
| 16 | Flexibility available in the software packages | 4.953 | 14 |
| 1 | Rapid changes in the business cycle. | 4.946 | 15 |
| 10 | Organizations prefer to change processes to gain advantages using packages | 4.919 | 16 |
| 8 | Ease of training | 4.912 | 17 |
| 13 | Availability of skilled End Users to operate the packages. | 4.899 | 18 |
| 6 | Shortage of information technology professionals | 4.669 | 19 |
| 3 | High failure rate of packages during development | 4.568 | 20 |
| **Variables** | | | |
| Desired Characteristics of Software Solution (Factor 1) | | 5.036 | 1 |
| High Cost and Risk Prone Tendency of the Needed Software (Factor 5) | | 5.020 | 2 |
| Administrative Motivation 1 (Factor 3) | | 5.017 | 2 |
| Quantum Improvement (Factor 6) | | 4.973 | 4 |
| Administrative Motivation 2 (Factor 4) | | 4.865 | 5 |
| Shrinkage in Systems Life Cycle (Factor 2) | | 4.824 | 6 |

### *Ranking of Variables and Data Items*

For the growth in usage of COTS/ERP software, the respondents perceived the top three variables as "Desired characteristics of software solution", "High cost and risk prone tendency of the needed software", and "Administrative motivation, system performance" (Table 12). The top six data items are "The packages can help in implementation of just-in-time/total-quality-management/business process reengineering", "Faster upgrades in hardware/software", "Availability of reliable software maintenance support", "Packages are critical to the operation of the organization", "Cost of development of packages", and "Reduced maintenance problems in the packages." The faster upgrades in software and hardware can be argued considering that the



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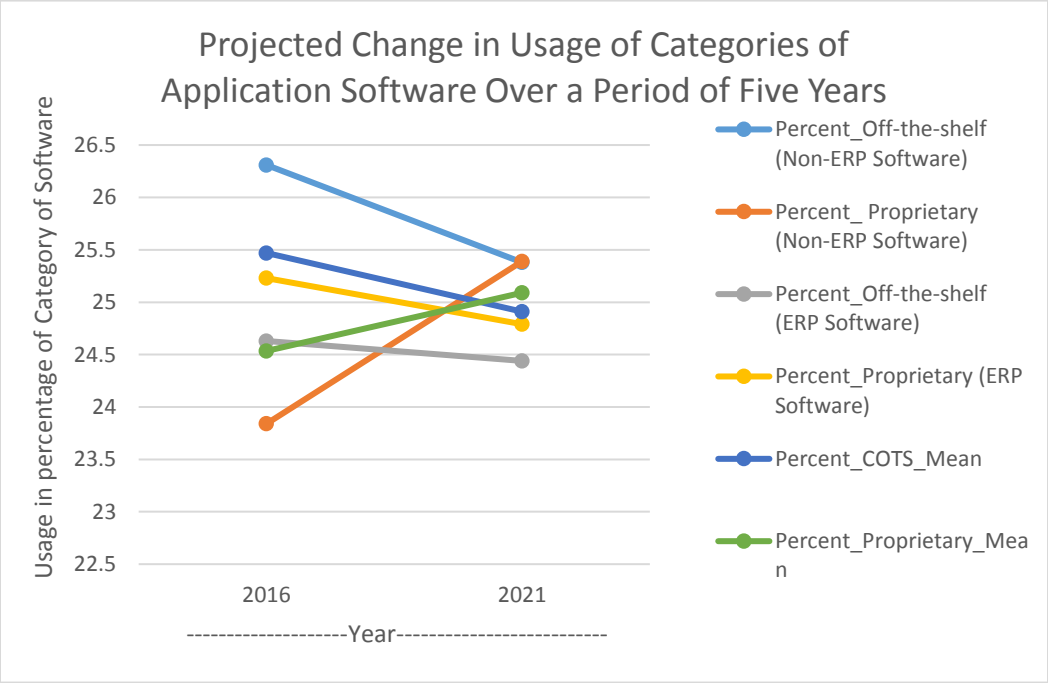
COTS/ERP packages are upgraded regularly and with the faster upgrades the organizations can get competitive advantages. In addition, the cost of development of proprietary packages which is relatively higher compared to COTS/ERP packages irrespective of benefits in costs due to automation in development of proprietary packages.

**Figure 3: Current and Projected Change in the Usage of Categories of Application Software.**




***Trends in Usage of Category of Software Packages***

The usage of all the four categories of software now and in five years from now (Figure 3) are approximately equal in percentage. The projected changes over five years in usage of categories of application software (Figure 3) reveals that the respondents perceive a marginal decline in off-the-shelf (Non-ERP), off-the-shelf (ERP), and proprietary (ERP) software. Only increase is projected for proprietary (Non-ERP) software from 23.84% to 25.39%. However, the current usage of COTS software (off-the-shelf – Non ERP and off-the-shelf – ERP) declined from 50.94 percent to 49.82 percent and usage of proprietary software (proprietary – non-ERP and proprietary – ERP) perceived similar increase from 49.07 percent to 50.18 percent. In other word we can say that most respondents perceive approximately equal usage of proprietary and COTS/ERP software currently as well as after five years.

***Analysis & validation of major hypothesis and contributing factors to support the trends in usage of COTS/ERP and proprietary packages***

This section provides a t-test analysis of the null hypotheses. Using this analyses, we determine of our hypotheses are supported. Through the t-test we are finding influencing factors on growth in categories of software by grouping respondents' perceptions about growth in COTS, and growth in proprietary application software/no growth in either of category.

**Table 13: Results of t-test showing association between Variables and Growth (Yes or No) in Usage of Various Categories of Software.**

| Variable | Growth | N | | Mean | | F | Sig | t | | Sig (2-tailed) | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Y | N | Y | N | | | Y | N | Y | N |
| Desired Characteristics of Software Solution | COTS | 39 | 109 | 5.396 | 4.907 | 4.714 | 0.032 | 2.076 | 2.502 | 0.04 | 0.014 |
| | Zero | 76 | 72 | 4.908 | 5.171 | 2.614 | 0.108 | -1.255 | -1.264 | 0.211 | 0.208 |
| Shrinkage in Systems Life Cycle | COTS | 39 | 109 | 5.188 | 4.694 | 0.665 | 0.416 | 1.973 | 2.218 | 0.05 | 0.04 |
| | Zero | 76 | 72 | 4.693 | 4.963 | 1.661 | 0.199 | -1.214 | -1.221 | 0.227 | 0.224 |
| Administrative Motivation, System Performance | COTS | 39 | 109 | 5.359 | 4.895 | 4.03 | 0.047 | 1.955 | 2.283 | 0.053 | 0.025 |
| | Zero | 76 | 72 | 4.931 | 5.108 | 1.102 | 0.296 | -0.835 | -0.838 | 0.405 | 0.403 |
| Administrative Motivation, HR | COTS | 39 | 109 | 5.06 | 4.795 | 1.089 | 0.299 | 1.04 | 1.133 | 0.300 | 0.261 |
| | Zero | 76 | 72 | 4.772 | 4.963 | 0.772 | 0.381 | -0.851 | -0.854 | 0.396 | 0.395 |
| High Cost and Risk Prone Tendency of the Needed Software | COTS | 39 | 109 | 5.192 | 4.959 | 1.202 | 0.275 | 0.974 | 1.062 | 0.332 | 0.292 |
| | Zero | 76 | 72 | 5.053 | 4.986 | 0.357 | 0.551 | 0.314 | 0.315 | 0.754 | 0.754 |
| Quantum Improvement | COTS | 39 | 109 | 5.564 | 4.761 | 3.306 | 0.071 | 3.24 | 3.877 | 0.001 | 0.000 |
| | Zero | 76 | 72 | 4.763 | 5.194 | 5.021 | 0.027 | -1.932 | -1.948 | 0.055 | 0.053 |

We divided the sample into two groups (growth: Yes or No) where respondents predicted growth in the requirement of each categories (COTS and zero growth) of application software (Table 13). The variables: desired characteristics of software solution and administrative motivation, system performance, have positive relationships with the growth in COTS software (including ERP-off-the-shelf) as stipulated in our revised model (Figure 2) having significant p <= 0.01 for F-test and t-test. In case of shrinkage in systems life cycle, the F-statistics is not significant, which suggests that there is no good model fit, however, the t-statistics is significant at p <= 0.05. These results



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shows that we can reject the null hypotheses for H1, H3, and H4 thereby confirming those hypotheses.

Additionally, the group of respondents who perceive zero growth in COTS packages is influenced by factor quantum improvement, where the F-statistics and t-statistics have significant negative relationships with $p <= 0.05$.

Using the results of t-test we can reject the null hypotheses for shrinkage of systems life cycle (H1), desired characteristics of software solution (H3), and administrative motivation, system performance (H4). We can summarize our findings by narrating that the growth in usage of COTS/ERP packages are significantly associated with shrinkage in systems life cycle, desired characteristics of software, and administrative motivation, HR.

## LIMITATIONS OF THE STUDY

As with any other study, this research also has several limitations that need to be discussed. First, the list of variables pertaining to IT related issues might reflect some biases. Although the literature was thoroughly reviewed and additional perspectives were obtained form IS academicians and managers, it is not claimed that these are the only variables that could be included. The loading of an item on more than one construct could be due to high intercorrelations of the factors, the accidental inclusion of an unidentified factor, or the absence of a factor that could result in items loading cleaner when the questionnaire is refined. While these possibilities are not mutually exclusive it appears that some of the cross loading occurs on questions that relate to ease of use. Since ease of use is a known determinant of intention to use (Venkatesh and Davis, 1996) it is likely that refining the items to more clearly reflect the role of ease of use in the decision process would add explanatory power. An instrument may need several administrations before its construct validity can be ensured.

Thus, it must be stressed that any interpretation of the findings must be made in lieu of the selected set of variables, issues, and categories. The questionnaire survey involved people from various departments such as information systems, administration, accounting/finance, production, etc. A balance among the number of respondents from each department could not be achieved. Furthermore, samples were collected from the manufacturing sector (automobile, computer hardware, pharmaceutical, telecommunication (hardware), and other) and service sector (banking, retail, hotels, computer software, construction, government, healthcare, insurance, technology, transportation, utilities, and other). Other types of organizations like airlines manufacturing, railway, chemicals, airlines operations, etc. are not included in the sample. Thus, any inferences based on the results might be restricted to the companies listed in the directory. The sample size is 148 which is moderate and approximately equally divided among manufacturing and service sectors.

## IMPLICATIONS FOR PRACTICE

This study has demonstrated that organizations are currently meeting their software needs by using approximately in equal percentages of all the four categories of application software [off-the-shelf (Non-ERP), off-the-shelf (ERP), proprietary-ERP, and proprietary-Non-ERP) and this can be expected to continue for the next five years. The approximately equal usage of COTS and



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proprietary software solutions in the organizations indicates the role of IT is moving towards a necessity but commodity like function. The organizations whose business strategy is not built around IT as a product or service prefer to invest the moderate amount on application software and should concentrate more on core product/services than IT applications for a competitive advantage. The equal usage of off-the-shelf/ERP solution in the organizations will require relatively fewer in-house IT professionals for development of proprietary software, maintenance of IT applications and infrastructure. In addition, for approximately 50 percent of COTS software, relatively fewer IT professionals having skills in business processes are needed for implementation of readily available application software. Further, the End-users training requirements are to be met by IT professionals as and when the need arises. For another 50 percent proprietary software, either IT department develop on their own or get the same from outsourcers. If they develop on their own, then they require a good number of IT professionals, otherwise, if it is outsourced, then their requirements can be met by fewer IT professionals. At the strategic level, the senior level of IT professionals is needed for formulating IT strategy and for advising to the organizations the needed IT architecture to meet changing needs of the functional departments. The trend towards natural language processing will make IT applications simple and the availability of knowledge workers and growth in EUC is expected to replace IT professionals from operations and maintenance of software applications. In many cases the End-users will be able to develop most of the smaller one-time applications by themselves. Further, they will contribute equally with in-house IT professionals in development, selection, and procurement of application software.

The current and future trends in the requirements of software categories will affect the curriculum of educational institutions. The IT curriculum must be redesigned equally to cater to the development and implementation needs of application software.

The organizations will rely on in-house IT department and on outsourcers, application service providers, and software houses. The vendor development and dealing with them is expected to be a vital function, as it is in manufacturing and other service sectors of the business. The faster rate of obsolescence in technology will warrant time-to-time consultations for in-house IT professionals for upgrading of their skill sets with external professionals in the field.

From the above, it can be argued that the current and future trends of usage of the various categories of software projected has far reaching implications for organizations and educational institutions. Consequently, it will influence the government policies and tax structure. Lastly, it can be argued that this trend may lead to a new era pertaining to applications software. This in-turn will open up tremendous opportunities for research.

## SUGGESTIONS FOR FURTHER WORK

This study provides several opportunities for future research. The results suggest that it might be useful to develop a number of comprehensive models. Thus, future research can extend this study to include additional factors such as organizational maturity, IS sophistication, effect of outsourcing/offshoring and cloud computing on growth in COTS/ERP and proprietary packages, etc; and to test a variety of such factors. In studying this, future research may also employ more rigorous methodologies using longitudinal approaches and non-linear relationships. The need for further refinement of the survey is also a priority. While the current survey items were able to help advance this exploratory research the amount of factors that cross-loaded is a concern. Further,



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with a broader sample and number of variables, the more generalized model can be developed. A comparative study of U.S. organizations with their counterparts in other nations can help the collaborations among them. In addition, a study on IT related issues on other industries in the United States -- i.e., airlines manufacturing, railway, chemicals, airlines operations, etc. -- can provide more generalization of results.

## CONCLUSION

The main objective of this study was to arrive at a better understanding of the current and future trends in the usage of categories of application software and its implications for organizations in the United States. The perceived usage of approximately equal percentage of COTS and proprietary solution leads us to believe that IT is not as much a source of competitive advantage as it was in the past to the corporations.

The results of t-tests reveal that the growth in the usage of COTS packages contributed by desired characteristics of software solution, administrative motivation, System Performance and shrinkage in systems life cycle as stipulated in our revised model (Figure 2).

For the growth in usage of COTS/ERP software, the respondents perceived the top three variables as desired characteristics of software solution, high cost and risk prone tendency of the needed software, and administrative motivation, System Performance, and top five data items as the packages can help in implementation of just-in-time/ total-quality-management/business process reengineering, faster upgrades in hardware/software, availability of reliable software maintenance support, packages are critical to the operation of the organization, and cost of development of packages. The faster upgrades in software and hardware can be argued considering that the COTS/ERP packages are upgraded regularly and with the faster upgrades the organizations can get competitive advantages. In addition, the cost of development of proprietary packages which is relatively higher compared to COTS/ERP packages irrespective of benefits in costs due to automation in development of proprietary packages.

The current and changing phase of software in approximately equal usage of COTS and proprietary packages will result in more reliance on outsourcers, application service providers, software houses, and consulting organizations. Because the organizations may use external agencies (outsourcers, application service providers, software houses, and consulting organizations) for development and/or maintenance of proprietary packages, the balance between in-house and external agencies may tilt towards external sources and there will be elimination of development activities to a great extent in the corporation and this shift is expected to trim in-house IT professionals significantly. The major work of in-house IT professionals will be in implementation of COTS/proprietary software and training to the End-users, in addition to partly development of application software. The senior IT professionals are expected to contribute in development of IT strategies and IT architecture, in collaboration with functional departments. The growth in knowledge workers, usage of COTS/proprietary packaged solutions, and trends towards natural language processing may lead to transfer of control on IT budget and IT human resources in the hands of End-users.



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## REFERENCES

Agrawal, V. K. (2005a). From proprietary software to off-the-shelf/ERP solutions: Identifications of critical factors. *National Social Science Journal*, 23, 9-32.

Agrawal, V. K. (2005b). Implications of environmental and cultural factors on the trends in usage of various categories of software. *National Social Science Journal*, *25*, 1-15.

Agrawal, V. K., Agrawal, V. K., Taylor, A., & Tenkorang, F. (2011). *Trends in IT human resources and its determinants.* In Luftman, Jerry *Managing IT Human Resources: Considerations for Organizations and Personnel*, 20-36, Hershey, PA: Business Science Reference (an imprint of IGI Global).

Applegate, L. M, Austin, R. D. & McFarlan, F. W. (2009). *Corporate information strategy and management: Text and cases.* New York, NY: McGraw Hill/Irwin.

Baker, R., Blumberg, S. J., Brick, J. M., Couper, M. P., Courtright, M., Dennis, J. M., Dillman, D., Frankel, M. R., Garland, P., Groves, R. M., Kennedy, C., Krosnick, J., Lavrakas, P. J., Lee, S., Link, M., Piekarski, L., Rao, K., Thomas, R. K., & Zahs, D. (2010). Research synthesis: AAPOR report on online panels. *Public Opinion Quarterly* 74:711–81.

Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of Management, 17*, 99-120.

Bartlett, M. S. (1950). Tests of significance in factor analysis. *British Journal of Psychology*, 3(Part II), 77-85.

Blankenship, A. B., Breen, G., & Dutka. A. (1998). *State of the Art Marketing Research* Second Edition, Chicago, IL: American Marketing Association.

Brynjolfsson, E. (1996). The contribution of Information Technology to consumer welfare. *Information Systems Research, 7*, 281-300.

Callegaro, M., & DiSogra, C. (2008). Computing Response Metrics for Online Panels. *Public Opinion Quarterly*, 72 (5): 1008-1032.

Carr, N. G. (May 2003). IT doesn't matter. *Harvard Business Review*. Boston, MA: Harvard Business School Press.

Carr, N. (2013). *The big switch: Rewriting the world from Edison to Google*. New York, NY: W.W. Norton & Co. Inc.

Churchill, G. A., Jr. (1979). A paradigm for developing better measures of marketing constructs. *Journal of Marketing Research*, 16, 64-73.

Clemons, E. K. (1990). MAC-Philadelphia national banks strategic venture in shared ATM networks. *Journal of Management Information Systems, 7*, 5-25.

Clemons, E. K. (1991). Evaluation of strategic investments in information technology.

*Communications of the ACM*, 34, 22-36.

Clemons, E. K., & Kimbrough, S. O. (1986). Information systems, telecommunications, and their effects on industrial organizations. In Maggi, L., Zmud, R., and Wetherbe, J. (eds), *Proceedings of the Seventh International Conference on Information Systems, San Diego, CA*, 99-108.

Davis, F. D. (1986). *A technology acceptance model for empirically testing new end-user information systems: Theory and results*. Doctoral Dissertation, Sloan School of Management, Massachusetts Institute of Technology, Cambridge, MA.

Dillman, D. A. (1978). *Mail and Telephone Surveys: The Total Design Method*. New York, NY: Wiley Intersciences.

Dillman, D. A. (2000). *Mail and Internet Surveys: The Tailored Design Method*, 2nd Edition. New York, NY: John Wiley Co.

Doll, W. J., & Torkzaddeh, G. (1988). The measurement of end-user computing satisfaction. *MIS Quarterly*, June, 259-274.

Edberg, D. T., & Bowman, B. J. (1996). User-developed applications: An empirical study of application quality and developer productivity. *Journal of Management Information Systems*, 13, Summer, 167.

El Sawy, O. A., Malhotra, A., Gosain, S., & Young, K. M. (1999). IT-intensive value innovation in the electronic economy: Insights from Marshall Industries. *MIS Quarterly*, Vol.23, September, 305-335.

Emery, J. C. (1990). Misconception about strategic information systems. *MIS Quarterly*, 14, June, VII-VIII.

Ettlie, J. E. (1983). Organizational policy and innovation among suppliers to the food processing sector. *Academy of Management Journal*, 26, 27-44.

Ford, J. K., MacCallum, R. C., & Tait. M. (1986). The application of exploratory factor analysis in applied psychology: A critical review and analysis. *Personnel Psychology, 39, 291-314.*

Guadagnoli, E., & Velicer, W. F. (1988). Relation of sample size to the stability of component patterns. *Psychological Bulletin*, 103, 265-275.

Hair, J., Anderson, R. E., Tatham, R. L., & Black, W.C. (1995). *Multivariate data analysis*. 4rt Edn. New Jersey, NJ: Prentice Hall Inc.

Hastie, S., & Wojewoda, S. (2015). Standish Group 2015 Chaos Report – Q & A with Jennifer Lynch. *InfoQ*, October 4, Retrieved from https://www.infoq.com/articles/standish-chaos-2015

He, Z. M., Kusy, K. M., & Zhao, T. (1998). A survey study of the current IS usage in the Chinese

manufacturing industry. *Information and Management, 34*, 285-294.

Heikkilä, J. T., Saarinen, T., & Sääksjärvi, M. (1991). Success of software packages in small businesses: An exploratory study. *European Journal of Information Systems, 1*, 159-169.

Himmel, M. A., & Grossman, F. (2014). Security on distributed systems: Cloud security versus traditional IT. *IBM Journal of Research and Development,* 58, Paper 3.

Hinkin, T. R., Tracey, J. B., & Enz, C. A. (1997). Scale construction: Developing reliable and valid measurement instruments. *Cornell University School of Hotel Administration: The Scholarly Commons*, Retrieved from http://scholarship.sha.cornell.edu/articles/613.

IDC (2016, August 29). *Worldwide IT Spending Forecast to Reach $2.7 Trillion in 2020 Led by Financial Services, Manufacturing, and Healthcare,* Retrieved January 19, 2017, from https://www.idc.com/getdoc.jsp?containerId=prUS41699316

Information Week. (2014). Federal IT spending slashed in proposed 2015 budget. March 5, Retrieved from http://www.informationweek.com/government/cybersecurity/federal-it-spending-slashed-in-proposed-2015-budget/d/d-id/1114126

Jeong, J. J., & Klein, G. (1999). Risks to different aspects of system success. *Information and Management*, 36, 263-272.

Jones, M. (1994). Don't emancipate, exaggerate: Rhetoric, reality and reengineering. In R. Baskerville, S. Smithson, C. Ngwenyama & J. I. DeGross (Eds.), *Transforming organization with Information Technology*. (pp. 357-378). North Holland: Elseiver Science.

Kaiser, H. F. (1970). A second-generation little jiffy. *Psychometrika*, 35, 401-415.

Kaiser, H. F. (1974). Little Jiffy, Mark IV. *Educational and psychological measurement*, 34, 111-117.

Kappelman, L., McLean, E., Johnson, V. & Torres, R. (2016). The 2015 SIM IT issues and trends, *Management Information Systems Quarterly Executive*, 15:1, 55-83

Kemerer, C. F., & Sosa, G. L. (1991). Systems development risks in strategic Information Systems. *Information and Software Technology, 33*, 212-223.

Kim, J., & Mueller, C. W. (1978). *Introduction to factor analysis: What it is and how to do it.* Beverly Hills, CA: Sage Publications.

Laudon, K. C., & Laudon, J. P. (1999). *Essentials of management Information Systems: Transforming business and management*. Upper Saddle River, NJ: Prentice Hall.

Laudon, K. C., & Laudon, J. P. (2015). *Management information systems: Managing the digital*

*firm*, 14th Edition. Upper Saddle River, NJ: Pearson Education Limited.

Lewin, S. G., Lewin, S. L., & Meisel, J. B. (1987). A dynamic analysis of the adoption of a new technology: The case of optical scanners. *Review of Economics and Statistics, 69*, 12-17.

Li, M. F., & Ye, R. L. (1999). Information technology and firm performance: Linking with environmental strategic and managerial contexts. *Information and Management*, 35, 43-51.

Lucas, H. C. (2000). *Information Technology for management*, 7th ed. New York, NY: McGraw-Hill, Inc.

Luftman, J., Derksen, B., Dwivedi, R., Santana, M., Zadeh, H. S., & Rigoni, E. (2015). Influential IT management trends: An international study. *Journal of Information Technology*, 30, 293-305.

Markus, M. L., & Benjamin, R. I. (1996). Change agentry–The next IS frontier. *MIS Quarterly*, December, 385-407.

Matheson, L. & Tarjan, R. (1998). Culturally induced information impactedness: A prescription for failure in software ventures. *Journal of Management Information Systems, 15*.

McLean, E. R. (1979). *End Users as Application Developers*. MIS Quarterly, 3(4), 37. doi:10.2307/249047.

McLean, E. R., Kappelman, L. A., & Thompson, J. P. (1993). Converging end-user computing and corporate computing. *Communications of the ACM, 36*, 79-92.

McNurlin, B. (Ed) (1991). *Trends in Information Technology*. Chicago, IL: Anderson Consulting.

Naukam, D. (2014). Finance must adapt to cloud-based subscription models. *Financial Executive*, Spring, 10-13.

Nidumolu, S. R., & Knotts, G. W. (1998). The effect of customizability and reusability on perceived process and competitive performance of software firms. *MIS Quarterly*, 105-137.

Nunnally, J. C. (1970). *Introduction to psychological measurement.* New York, NY: McGraw-Hill.

Palvia, Prashant, & Wang, P. (1995). An expanded global information technology issues model: An addition of newly industrialized countries. *Journal of Information Technology Management*, VI, 29-39.

Porter, M. (1980). *Competitive strategy*. New York, NY: Free Press.

Porter, M. E. (1996). What is a strategy? *Harvard Business Review*, November/December.

Rahman, W., & Kurien, P. (2007*). Blind men and the elephant: demystifying the global IT services industry*. (pp. 136-137) Thousand Oaks, CA: SAGE Publications.

Morton, S. (1991). *The corporation of the 1990s: Information Technology and organizational transformation*. Oxford University Press.

Srinivasan, S. (2013). IS security realistic in cloud computing? *Journal of International Technology and Information Management*, Vol. 22, 47-66.

Sturdy, G. R. (2012). *Customer relationship management using business intelligence.* Newcastle upon Tyne, UK: Cambridge Scholars Publishing.

Tabachnick, B. G., & Fidell, L. S. (2007). *Using multivariate statistics*. Boston, MA: Pearson Education Inc.

Turban, E., McLean, E., & Whetherbe, J. (2001). *Information Technology for management: Making connections for strategic advantages*, 2nd ed. New York, NY: John Wiley and Sons, Inc.

Turban, E., & Volonino, L. (2011*). Information technology for management: Improving the strategic and operational performance*, 8th edition. New York, NY: John Wiley and Sons, Inc.

Turban, E., Volonino, L., & Wood, G. (2015). *Information technology for management: Digital strategies for insight, action, and sustainable performance*, 10th edition. New York, NY: John Wiley and Sons, Inc.

Turner, J., & Kambil, A. (1994). Outsourcing of information systems as a strategy for organizational alignment and transformation. *Unpublished Paper, Stern School, New York University, NY.*

Venkataraman, N., & Short, J. E. (1992). Baxter Healthcare: Evolution from ASAP to value link in the hospital supplies marketplace. In *Proceedings of the Twenty-fifth Annual Hawaii International Conference on System Sciences*, Vol.4,.666-677.

Venkatesh, V., & Davis, F. D. (1996). A model of the antecedents of perceived ease of use: Development and test. *Decision Sciences*, 27, September, 451-481.

Wailgum, T. (October 2007). How Wal-Mart lost its technology edge. *CIO*. Retrieved from http://www.cio.com/article/print/143451

Winter, S. J., Chudoba, K. M., & Gutek, B. A. (1997). Misplaced resources? Factors associated with computer literacy among end-users. *Information and Management*, *32*, 29-42.



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